Agriculture Canada

ECONOMIC MODELING IN AGRICULTURE CANADA: PAST AND FUTURE*

(Working Paper 12/87)

Zuhair A. Hassan
Shankar Narayanan

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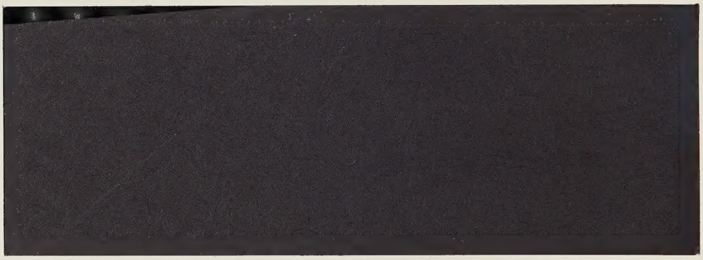
Policy Branch

Direction générale des politiques



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Shankar Narayanan

Policy Branch
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*This paper updates and expands "Review of Economic Modeling in Agriculture Canada," a paper presented by H. Bruce Huff at the Econometrics Symposium, May, 1980, Ottawa.

Contents

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Zuhair A. Hassan
Shankar Narayanan

Executive Summary

This paper presents a historical overview of the various economic modeling efforts undertaken by the department and provides some perspective for future modeling requirements.

History

The history of economic model development in Agriculture Canada can be segmented into four distinct time periods. Prior to 1972, there was virtually no quantitative economic model development in Agriculture Canada. This was followed by the 1972-77 period of rapid implementation of a variety of quantitative modeling approaches. During the 1978-81 period, the main thrust was on developing the (econometric) Food and Agriculture Regional Model (FARM). Since 1982, most of the modeling activity has been concentrated on improving and operating FARM, reviving the Canadian Regional Agriculture (programming) Model (CRAM), developing an Input-Output Model for the agriculture sector, adapting and updating a number of farm-level models, and developing the Canadian component of an international model constructed by the International Institute for Applied Systems Analysis (IIASA).

Existing Models and their Uses

- The FARM is a large quarterly econometric model of the Canadian agriculture sector encompassing all major commodities. This model is regularly used to generate short and medium-term forecasts. FARM is also used in many policy development and evaluation exercises. These include the assessment of various stabilization schemes for livestock and grain, impact of different levels of initial prices of wheat in 1986-87, and the impacts of European Economic Community (EEC) beef imports, U.S. corn imports, and U.S. countervail on Canadian hogs and pork.

- CRAM is a spatial linear programming model with crop and livestock activities specified on a provincial and regional basis. Interregional and international trade impacts can be analysed with predetermined provincial and national demands being met at exogenously determined prices. The CRAM has been used to analyse a variety of policy issues, e.g. the introduction of medium quality wheat, impact of compensatory grain freight rates, and the impact of the 1985 U.S. Food Security Act on the grain sector in Canada.

- The Agriculture Canada Input-Output Model is a general equilibrium macroeconomic model of the Canadian economy with agriculture sector disaggregated into 12 primary and 19 processing sectors. Since the model has been only recently developed, it has been employed in relatively few policy situations, eg. the impact on the Canadian economy of an increase in wheat exports, a food aid policy simulation, and the implications of an international grains acreage set-aside program on the Canadian agri-food sector.

- Farm and enterprise level policy analysis models are capable of simulating the performances of individual farms and enterprises. These models are available for major farm type (grains and oilseeds, beef, hog, dairy) and by region and are used to analyse the distributive impacts of policies and programs, at the representative farm levels.

Other Features

Staff development has been a most important spin-off from modeling activity. Another important by-product from modeling is the creation of new data bases. Complementing the analysis of the market specialists with model results have resulted in drawing infrences much superior to those that either can produce independently.

Future Work

Future work in the modeling area is expected to focus on improving farm-level analyses, developing further the international and domestic policy analysis capability and enhancing the analytical capabilities of the CRAM, the Agriculture Canada Input-Output Model, and the longer-term forecasting capability of FARM.

INTRODUCTION

Large-scale economic modeling has played a significant role in the programs of Agriculture Canada. This role has included extensive use of models in policy analysis, market intelligence, short- and medium-term forecasting, and interdisciplinary research activities.

The objectives of the present paper are to provide a historical overview of the various economic modeling efforts undertaken by the Department; to describe currently used models; to list some of the lessons learned from the modeling experience; and finally to provide some perspective for future modeling requirements. The organization of the paper follows the sequence in which these objectives are listed.

HISTORY OF ECONOMIC MODELING IN AGRICULTURE CANADA

This section outlines the chronological process of model development at Agriculture Canada. It also contains a brief rationale for the differences in approach, activity level and type of problem addressed. The models cited refer to those either constructed by departmental staff or built under contract. The review does not present an exhaustive account of all modeling efforts. Rather, it highlights only the major modeling accomplishments.

The history of economic model development in Agriculture Canada can be segmented into four distinct time periods. Each period is influenced by different sets of staff members, policy issues and economic events. Prior to 1972, there was virtually no quantitative economic model development in Agriculture Canada. This was followed by the 1972-77 period of rapid implementation of a variety of quantitative modeling approaches. During the 1978-81 period, the main thrust was on developing the (econometric) Food and Agriculture Regional Model (FARM).

Since 1982, most of the modeling activity has been concentrated on improving and operating FARM, reviving the Canadian Regional Agriculture (programming) Model (CRAM), developing an Input-Output Model for the agriculture sector, adapting and updating a number of farm-level models, and developing the Canadian component of an international model constructed by the International Institute for Applied Systems Analysis.

Modeling prior to 1972

During this period there was very limited activity in modeling within the Department. Most modeling work was of the farm management type as outlined in the review by Hedley, Sonntag and Thompson (1973) or involved only simple regression analysis such as those used to estimate retail food demand (Shefrin and Yankowsky 1966).

Some of the reasons for the lack of quantitative modeling during this period are related to the fact that these techniques had not yet been fully developed by the agricultural economics profession. Also, these techniques were experimental at that time and therefore were not necessarily appropriate for application by government research organizations responsible for policy analysis.

A discussion of the problems of using quantitative models in the policy development process during this period is outlined by Hiscocks (1972), Craddock (1972), and Warley (1972). Hiscocks describes the process of developing a feedgrains policy following the LIFT acreage diversion program in 1969-70: "as only three months were available and under this time pressure no research could be undertaken, no new data produced." Craddock states: "agricultural economists have not become involved to any significant extent in quantitative analysis for policy formation purposes" because of funding limitations for team research and a lack of basic data collection for analysis. Warley notes that research relevant to policy generally had been "episodic, non-cumulative and not noticeably successful in being anticipatory."

The 1972-77 period

During this period, a major increase in model activity was triggered primarily for two reasons. First, a major study conducted by a Federal Task Force on Agriculture (1969) recommended shifting resources out of slow-growth areas, reducing subsidies, and improving management tools available to producers. In response, Agriculture Canada adopted a food systems approach, assuming a broadened mandate for three growth commodities: beef, feedgrains and oilseeds. With this change, 35 new positions for economists were created to identify the potentials and constraints within a total production-marketing system. Most of this large increase in staff was allocated to economic research, many of whom were newly trained and had substantial quantitative skills. As a result, an increase in modeling activity occurred.

The second change was that senior Department officials were communicating directly with senior researchers on several important policy issues. Because of the relatively small size of Agriculture Canada, there was very timely linkage between policy decisions and model builders.

In addition, a number of important issues relevant to key areas of production and marketing in agriculture were also identified, namely transportation and distribution (especially grains), instability of prices and production, foreign trade, uncertainty in commodity outlook, accelerating production and production adjustments, and demand analysis. To analyze these issues and to examine alternative solutions, use of quantitative models became imperative. This encouraged rapid development of the required quantitative tools.

First, a large linear programming (LP) interregional competition model was developed to analyze the equity and efficiency issues relating to feedgrain marketing and transportation (Kerr and Eyvindson 1974). Later, this model was improved to examine the implications for livestock

production and meat transportation (Harvey and Huff 1974). A subsequent LP model was developed to examine the prairie grain-handling and transportation system capable of answering questions on system efficiencies and rationalization (Eyvindson 1975).

Second, reexamination of existing stabilization programs, prompted by the disastrous profitablity situation for livestock producers in the early 1970s, resulted in the development of new models to estimate the costs and payouts under alternative policies for a revised Agricultural Stabilization Act and a new Western Grains Stabilization Act (Hedley and Cushon 1974, and Chin et al 1975).

Concurrently, in the international trade area, to support Canada's position in GATT Tokyo Round negotiations, a general equilibrium LP model was developed to evaluate the effects of Canadian trade policy on Canadian commodity production by region (Lattimore and Thompson 1978). A simulation model for the major world wheat production and consumption regions was also constructed (Lattimore and Zwart 1978). A beef and pork quadratic programming model was also constructed to evaluate the impact of quotas and embargoes on livestock trade between Canada and the U.S. and Oceania (MacAulay 1976, 1978).

Third, to provide commodity outlook and to support policy analysis, several commodity models to independently forecast commodity outlook in the short, medium and long terms were also developed (Chin <u>et al</u> 1974, Harrington and Sahi 1974, Hassan and Huff 1978a and 1978b, and Jaffrelot 1977). These models were largely econometric, but their basic parameters were also used in a quadratic programming framework.

Fourth, pertaining to micro-level production and planning, a number of farm-level simulation models for farm planning and budgeting purposes (Lethbridge models) were developed (Hedley, Sonntag and Thompson 1973). This area received a great amount of emphasis because of the research resources associated with CANFARM's national computerized farm

record-keeping service. Farm-level models generated the input-output coefficients used in a national LP production model designed to provide information on optimal land use and livestock production patterns under various policies and economic scenarios (Thompson, 1977).

Fifth, adjustments in the dairy sector were a continuing concern, and two models were developed for various policy and program evaluations (Sahi and Harrington 1974).

Lastly, another major area of modeling work initiated in this phase was demand system analysis. Results from the demand studies have been widely applied in policy analysis, other modeling work and market intelligence (Hassan and Johnson 1976a, 1976b, 1977a, 1977b and Hassan, Johnson and Green 1977).

The 1978-81 period

During this period, modeling development and analysis witnessed a remarkable change. First, because of a more stable economy, favorable export market demands and a need for political agreement to settle grain transport rate issues, etc., model-oriented economic analysis needs were considerably reduced. Second, privatization of the CANFARM program, as well as loss of key research staff in the model-building area, also led to a reduction in model development activity per se during this period.

As a result, all available economic modeling resources during this period were devoted to initiating development of a large-scale econometric forecasting model (Food and Agriculture Regional Model or FARM). The need for the project arose primarily to study the impact of the rapid escalation and volatility in agricultural and food prices in the middle 1970s on the economy and on the inflation rate, and also to provide an economic forecast on the future outlook for commodities. The research funds obtained for this project also enabled the Department to contract a sizable part of this project to five Canadian universities to develop various modules of the FARM.

During this period, further modeling and analysis work pertaining to consumer demand was also undertaken in the following four areas: commodity demand functions, Engel analysis, food demand matrix, and complete demand systems (Hassan and Johnson 1984).

During the latter part of this period, the Department also undertook to modify and adapt the set of Lethbridge farm-level simulation models for policy and economic analysis of national issues.

The period 1982 to present

The initiatives during this period were mainly to support the analytical needs of the agri-food strategy. In particular, the discussion paper "Challenge for Growth: An Agri-Food Strategy for Canada," released in July 1981, proposed a three-point program to encourage the growth and development of the agri-food sector. The three components to the strategy were: market development, strengthening of the supply base, and mission-oriented agricultural research.

The design of appropriate policies for development of the agri-food sector required comprehensive analysis to assess the impact of policy alternatives on the objectives of the strategy, as well as considerations of distributive equity among regions, commodities and market participants. The policy decision process normally does not provide adequate time for the development of specific analytical techniques for each policy issue. Therefore, it is critical for effective policy development to have a number of analytical tools that can be used for a range of potential policy issues.

As a consequence, most of the modeling activities during this period were concentrated on improving FARM, developing the Canadian Regional Agricultural Model (CRAM), the Agriculture Canada Input-Output Model, and a small group of farm-level models. Also during this period, farm-level policy analysis capacity was further enhanced by adapting a

set of whole farm stochastic models and by using enterprise budgeting systems from different sources. Technical development in computable General Equilibrium models enabled the development of a large world model (International Institute for Applied Systems Analysis World Food Model) emphasizing commodities and individual country policies. Agriculture Canada participated in this development and applications of the model.

CURRENT MODELS IN AGRICULTURE CANADA

This section presents a comprehensive account of all the models currently operational or used in policy analysis in the Policy Branch. These are: the Food and Agriculture Regional Model (FARM), the Canadian Regional Agricultural Model (CRAM), the Agriculture Canada Input-Output Model, and the farm-level models (whole farm and enterprise). It should be noted that other efforts devoted to quantitative economic analysis in the branch, e.g. demand analysis, food industry productivity etc. are not covered in this review.

The Food and Agriculture Regional Model

The Food and Agriculture Regional Model (FARM) is a quarterly econometric model of the Canadian agri-food sector. It is designed to structurally represent and, at the same time, quantify the important production, consumption, inventory, trade, and price relationships of and among key commodities within the Canadian agri-food sector, and to provide certain aggregate statistics that give an indication of the performance of the sector as a whole.

FARM currently has 715 equations including the following major components: agricultural commodities, the food sector, and farm income (including farm inputs). Within the commodity components, there are blocks for grains and oilseeds, beef, pork, sheep and lambs, poultry and eggs, and dairy. Some of the blocks in FARM are disaggregated geographically on a regional basis (i.e., eastern and western Canada).

Table 1 displays the detailed coverage of FARM in terms of commodities/sectors, and regions. Also, the number of equations in each block of the model is indicated.

FARM currently has 208 exogenous variables. The major exogenous influences in FARM are: U.S. agricultural prices, such as those for wheat, soybeans, corn, steers, etc.; and Canadian macroeconomic variables, such as the Canada-U.S. exchange rate, interest rates, energy prices, and per capita disposable income.

The primary uses of FARM are for short- and medium-term forecasting and policy analysis. The FARM model is used to generate short-term forecasts (two years) once each quarter as an input to the Department's official forecast in the Market Commentary. It is also used to generate two medium-term forecasts (five years).

FARM has been used on numerous occasions to analyze alternative policies. For example, in the spring of 1985, FARM was used to assess the impact of various livestock stabilization schemes in Canada. The results were presented at a workshop on livestock stabilization in May 1985; also, the results were presented to the federal-provincial Tripartite Committee on Red Meat Stabilization.

FARM was used to assess the impact of different levels of initial prices for wheat in 1986-87. The primary concern was with the impact on seeded area, and on farm net income. Most recently, the pork component of FARM was used to assess alternative marketing systems for hogs in Canada, using both historical and forecast simulations, and the results were the focal point of a national industry workshop. It has also been heavily used by the Canadian Import Tribunal and industry groups to assess the impacts of EEC beef imports, U.S. corn imports, and U.S. countervail on Canadian hogs and pork.

The Canadian Regional Agricultural Model

The Canadian Regional Agricultural Model (CRAM) is a spatial linear programming model with crop and livestock production activities specified on a provincial and regional basis. It allows trade interregionally and internationally with predetermined provincial and national demands being met at fixed prices which are determined exogenously (MacGregor and Graham 1987).

The country is divided into 29 crop-producing regions; 7 in Alberta, 9 in Saskatchewan, 6 in Manitoba, and 1 in each of the other provinces. Prairie crop regions correspond to those defined for the National Farm Survey. Livestock production and domestic demand are specified at the provincial level (with the four Atlantic provinces considered as one region). Livestock feedgrain demands are met first from provincial supplies and then through interprovincial shipments as required. The commodity breakdown for grains and oilseeds production includes wheat, barley (including oats and rye), flax, canola, grain corn, soybeans and an aggregate of other crops (expressed in value rather than quantity terms).

Besides fairly comprehensive beef and pork components, single activities in each province for dairy, chicken and poultry are included. Land of different classes, opening and closing livestock numbers and historic crop production patterns constrain the solutions obtained in the production subsector of the model. Trade takes place between production and consumption points. From each crop region, all major grains are shipped for use at the provincial level for feed or domestic consumption, with surpluses shipped to deficit provinces and to export points at Vancouver and Thunder Bay for Prairie grains. Live animals and livestock products are shipped between provinces, with surpluses exported.

The CRAM model can respond to a variety of questions for the grain sector and to a lesser extent in the livestock sector, usually with limited additional information or modifications to its specification. Exogenously determined changes in livestock output or inventories will affect grain supplies available for export, along with livestock and meat trade balances. In the grains component, changes in price levels and relative profitabilities will be reflected in changing production patterns and output levels at the regional level. Resource availabilities affect production patterns. Grain transportation issues can be investigated (changing policies, rates, constraints). Technological change can be studied as new crops are introduced or yields change over time. Development issues can also be explored as resource constraints and the opportunity costs of promoting production in different regions (regional comparative advantage) are changed.

Issues analyzed to date include: introduction of HY320 (medium-quality wheat) on the Prairies, impact of compensatory grain freight rates on the Prairies, and the impact of the 1985 U.S. Food Security Act on grain production patterns, resource use and farm income.

The Agriculture Canada Input-Output Model

The Agriculture Canada Input-Output Model is a general equilibrium macroeconomic model of the Canadian economy. The model contains 200 industries and 602 commodities. The agriculture component of the model consists of 12 primary agriculture sectors and 19 processing sectors. These industries produce 97 commodities in the model.

The model is designed to show the interrelationships between industrial sectors in the economy and the commodities they produce. These relationships define the backward linkages; that is, they define the commodity inputs for any industry as well as the forward linkages, and show which industrial sectors will use the commodities produced by any industry in the economy. This is the only model that directly identifies the farm/nonfarm linkages in the economy.

The model is developed using an accounting framework that accounts for the supply and disposition of all commodities produced in the economy. This framework is composed of three matrices: Use, Make and Final Demand. The Use matrix defines the commodity inputs going into the production of all of the industrial sectors, the Make matrix provides a distribution of the commodities produced by the industrial sectors, and the Final Demand matrix shows the disposition of commodities by domestic and foreign end users.

The model is demand-driven; that is, goods and services are produced in the economy in order to satisfy a final demand. This enables the Department to estimate the impact of changes in domestic and export demands for commodities. The advantage of the input-output model is that the estimated impacts take into account the direct, indirect and induced effects of the change in final demand. This means that the estimated impact takes into consideration not only the effect on the industrial sector that produces the commodity (the direct effect) but also the impact on all the input industries that supply inputs to that industrial sector (the indirect effect). Finally, the model can also be used to estimate the impact of the increased household expenditures that would result from the increase in the final demand for the commodity (the induced effect).

An important feature of the Agriculture Canada Input-Output Model is the disaggregated agriculture sector. This disaggregation allows the model to be more responsive to the types of policy analysis that affect the agricultural-industry complex. The 12 primary agriculture sectors or farm types found in the model are: dairy, cattle, hogs, poultry, wheat, small grains, field crops, fruit and vegetables, miscellaneous specialty, livestock combination, field crop combinations, and other combinations (Thomassin and Andison 1987).

Since the model has been developed only recently, it has been employed in relatively few policy situations. These include the impact on the Canadian economy of an increase in wheat exports of $100 million, a food aid policy simulation, and the implications of an international grains acreage set-aside program on the Canadian agri-food sector.

Farm-level modeling

Farm-level modeling and analyses, under the responsibility of the Farm Development Policy Directorate (FDPD), are organized as shown in Figure 1. Tables 2, 3 and 4 summarize the situation with respect to available models, unit of analysis (farm profiles), and applications, respectively.

Farm-Level Models: Farm-level models fall under two categories: whole farm models and enterprise models. There are two classes of whole farm models: dynamic simulation models specific to regions and farm types (e.g., Lethbridge models); and the dynamic simulation/optimization model applicable to all regions and farm types (e.g., USDA "Repfarm" model). Presently, the Lethbridge Simulation models are functional for grains and oilseeds, beef-forage-grain, and hog-grain farms in the Prairies, grain farms in Ontario, and dairy farms in the West and East.

The Lethbridge models are somewhat limited in their ability to analyze policy and economic issues because of the static nature of the production, price, policy and some macroeconomic variables defined in the model. The "Repfarm" model is more versatile and provides several options for farm-level policy and economic analyses, because of its ability to: endogenize a selection of production activities; stochastically vary prices, cost and yields; and include wide ranges of policy and taxation choices. All whole farm models are fully operational. The "Repfarm" model, however, is being modified to make it fully consistent with the Canadian situation with respect to taxation and policy options.

The enterprise models are constructed by means of a single system, Microcomputer Budget Management System (MBMS), which is capable of generating realistic and consistent enterprise level budgets for representative grain and livestock farms by size, technology type and region. The MBMS is a static system but applicable to all enterprises and regions (general purpose). This system is fully operational. Some developmental work is, however, envisaged to permit metric and bilingual outputs and to revise some cost calculation procedures such as machinery and building depreciation. In addition, testing of the suitability of MBMS for livestock enterprises involving breeding herds (e.g., cow-calf) and perennial crops (e.g., apples) is also needed. This system is "data hungry" and needs a substantial inflow of basic information to be fully exploited.

The Department also maintains a physical and economic analysis model named SOILEC, which is a dynamic simulation model applicable to different enterprises/ farms/regions and for different soil type. The SOILEC model computes soil erosion rates and related long-term on-farm economic impacts, and has been applied for erosion control policy evaluation.

Representative Farm Profiles: Table 3 presents the typical "farm profiles" that have been developed. Farm profiles for grain, beef, and hog enterprises by major soil zones and sizes in the Prairie provinces, and for average grain farms in western, southwestern and eastern Ontario have been completed to date for Lethbridge whole farm model applications. The majority of these profiles were developed under contract for specific projects. Lately, farm profiles for Quebec beef feedlot farms have also been developed. These are to be employed in analyzing financial viability of these farms using the "Repfarm" model.

Likewise, for MBMS applications, representative farm profiles of sugarbeet, white bean, and potatoes have been also developed. In addition, subsector profiles for various segments of the livestock industry are being currently developed.

Farm-Level Analyses: Table 4 summarizes the farm-level analysis projects completed to date. These projects employ farm-level models and data profiles and relate mostly to analyzing the farm-level impacts of the variation in macroeconomic and policy variables: for example, interest rates, inflation, energy prices, and government program payments. In addition, projects to analyze the farm-level impact of the introduction of new crop(s), new tillage system(s), alternative fertilizer placement methodologies, and soil conservation systems have also been completed. The results of these analyses have been utilized in various policy evaluations and briefings, including a report to the Committee of Enquiry on Crow Benefit Payment, an analysis of the Ontario Integrated Development Project and the Special Canadian Grains Program.

Regarding enterprise-level analysis, the MBMS has been employed since 1984 to generate cost-of-production information to support ASA and tripartite stabilization programs. So far, enterprise budgets have been completed for potato producers in Prince Edward Island, New Brunswick, Quebec and Ontario, for sugarbeet producers in Quebec, Manitoba and Ontario, for white bean producers in Ontario, for grain corn and soybean producers in Ontario, and for small grains in all provinces except Nova Scotia, British Columbia and Ontario. In addition, demonstration budgets based on hypothetical livestock farm profiles have been tested and validated. Plans are under way to prepare realistic budgets for livestock enterprises.

LESSONS AND OBSERVATIONS

From the lessons and insights gained from this long experience of economic modeling and its application to forecasting and policy analysis, the following points regarding the construction, application, validity and allocation of resources for such models are observed:

- Models require large spatial and temporal data sets on all the model variables. These data sets must be maintained up-to-date for proper validity of results.

- Models can neither be constructed nor adapted to analyze a variety of policy issues. Therefore, it is the responsibility of management to properly anticipate major future policy questions and position the modeling effort accordingly.

- In a government department, the need for ad hoc, timely reponses to a variety of policy issues comes up very frequently. As such, considerable analytical resources can be used up to fulfill these needs. In allocating its analytical resources, management finds it difficult to achieve a proper balance between development of analytical capability for future policy analysis needs and generating quick responses to ad hoc policy issues.

- In policy evaluation research, economic analysts frequently get bogged down in responding to specific questions on the issues the research is designed to investigate and therefore do not have time to focus on current economic analysis activity or to anticipate policy issues over prolonged periods. Managers must decide how best and when to commit the researcher's time.

- Models cannot be used independently of analysts. Models consider only part of the total information or factors available and require this supplement to ensure completeness and relevance. Analysts have a different information set from which to work. The combination of both types of information can provide results superior to those that either can produce independently.

- Staff development has been a most important spin-off from modeling activity. Model development has unquestionably improved the analytical capabilities of the economists involved. The discipline associated with a model which requires an explicit specification of factors to be considered is one element of this. The techniques and procedures used in the development of one model are often transferrable to another.

- The development of a database is also an important by product from modeling. These data bases are available for other uses, which can greatly accelerate their progress. As well, it facilitates monitoring of industry performance and preparation of briefing material.

ASSESSMENT OF FUTURE REQUIREMENTS

Future work in the modeling area is likely to concentrate on improving farm-level analyses, developing further the international and domestic policy analysis capability, and enhancing the analytical capabilities of the CRAM, the Agriculture Canada Input-Output Model, and the longer-term forecasting capability of FARM. Improving farm-level analyses could be accomplished by enhancing the analytical capabilities of the models as well as the quality and type of data collected for the operation of farm-level models. Since 1985 the International Trade Policy Division (International Programs Branch) has been developing a world agricultural trade model incorporating major Canadian-produced commodities (TASS) for the principal purpose of assisting policy decisions about multilateral trade negotiating strategies. This ongoing

work is complemented by the support for the operation of a North American Center for the International Institute for Applied Systems Analysis (IIASA) World Food Model at Iowa State University. Respecifications of various equations in FARM and incorporation of results into the models are currently being undertaken by the Market Outlook and Analysis Division of the Policy Branch.

Farm level analyses

For future farm-level analysis requirements, two requirements are essential: to have representative farm profiles in sufficient detail for reliable policy and economic analysis of the commercial farm subsectors, especially the grains and oilseeds sector; and to be qualitatively and quantitatively equipped with farm-level models to analyze issues pertaining to various policy areas (prices, income, finance, subsidy, technology, taxation, etc.). This means that future efforts will be directed to two main areas. The first is the need for a reexamination of the information needs on physical and financial aspects of representative farm profiles for the commercial farm subsectors in order to assess the gaps between these needs and the available farm-level data, to devise ways and means to bridge the farm-level data gap, if any, and to establish a farm-level data system for reliable policy and financial information on an ongoing basis. The second area is review of the micro modeling capacity with a view to adequately strengthen the capability of the farm-level policy models as needed. With respect to the former, recognizing the lack of farm-level data pertaining to the physical and financial aspects of the commercial farm subsectors by region and type, a special project team has been established, with a mandate to develop for implementation in 1988 a farm-level data collection and handling system. The system would provide the needed physical and financial information required to construct and maintain the farm-level data base. With regard to the latter, a new Representative Farm Analysis unit has been established in the FDPD since April 1987, with a view to enhancing analytical capability and policy analyses.

Although at present priority is assigned to the grains and oilseeds sector, ultimately it is envisaged that the Department should be equipped with sufficient capability to provide analysis of the likely responses of farms in various regions, commodities, size, financial and other situations to various market conditions and policy provisions, including their distributive effects.

International trade modeling

In-House: The International Trade Policy Division (ITPD) has been developing an agricultural trade model (TASS) with the aim of providing information that will be relevant and useful to Canadian teams in multilateral negotiations insofar as they relate to agricultural trade.

TASS is a policy simulation model. It is designed to simulate the effects of changing any Canadian or foreign agricultural commodity policy (domestic or border) with signficant trade impacts, either alone or in combination. Effects to be measured include price effects (world, domestic producer, domestic consumer), volume effects (production, consumption, net trade, processing) and value effects (export receipts, import payments, producer revenues, consumer expenditures, government expenditures, government receipts). It will thus identify potential costs to Canada and potential gains to other countries from contemplated Canadian policy changes, and potential gains to Canada and potential costs to other countries of contemplated foreign policy changes. These are all important considerations for purposes of choosing negotiating strategies and for identifying potentially acceptable tradeoff offers.

The emphasis in this model is on capturing interdependencies between countries and between major temperate agriculture commodities. For example, the model would generate the implications of a change in EEC sugar policy for, inter alia, U.S. grain producers and Canadian hog producers and pork consumers. Incorporating the facility for simultaneous solution across several countries and commodities, in order

to focus on identifying the interdependencies, comes necessarily at a cost of loss of detail on individual commodities and countries. The results it generates should thus be regarded as complementary to, rather than as competitive with, the results of analyses with more disaggregated single-commodity and single-country (e.g., regional) models. Its flexibility and relative simplicity will allow it to be used to analyze a much broader range of options than is feasible with larger general equilibrium and/or dynamic international trade models, with which it can thus also be regarded as complementary.

The TASS approach is partial equilibrium comparative statics. The main objective is to measure major medium- to longer-term impacts of policy changes, such as would be apparent, say, in five to ten years, after production and consumption patterns had fully adjusted to the new economic realities. This model is not intended to generate answers to questions about short-term impacts or the dynamics of the adjustment path. Since negotiated policy changes are usually phased in gradually and since the negotiation process itself tends to extend over a period of years, it is judged that information on longer-term impacts will be more useful to negotiators.

To a large extent, the TASS is an adaptation of the OECD Secretariat's current agricultural trade modeling work. The major difference from the OECD approach is that each country's programs and policy elements are to a much greater extent represented individually in TASS, rather than collectively as a general "subsidy equivalent." For Canadian purposes, this is important, since trade negotiations are likely to be more about specific measures or types of measures than about general levels of income support. Other differences are that the commodity coverage of TASS is somewhat different to reflect items particularly important in Canada's agricultural trade, while the number of world trading countries/regions is fewer in TASS (Canada, U.S., EEC, Japan, and all others).

This is a synthetic model in the sense that the underlying demand and supply parameters (own-price and cross-price elasticities) are not estimated but are assumed on the basis of consideration of a range of available estimates from previous empirical studies. A linear supply and demand structure is assumed. Commodities included are wheat, feedgrains, rapeseed, rapeseed oil, soybeans, soybean oil, oilseed meal, slaughter cattle, beef, slaughter hogs, pork, poultry meat, eggs, milk, butter, skim milk powder, cheese and evaporated milk. Approximately 500 equations make up this just-identified simultaneous system. TASS is currently being tested, refined, and updated to incorporate existing policies in Canada and the three other major agricultural traders.

Outside Contracting: A North American Center (NAC) for the International Institute for Applied Systems Analysis, Food and Agricultural Policy program, has been established recently at Iowa State University. Participating institutions in this cooperative endeavour include the Center for Agricultural and Rural Development of Iowa State University, the Economic Research Service of USDA, the Policy Branch of Agriculture Canada, the National Center for Food and Agricultural Policy at Resources for the Future, and the Department of Agricultural Economics at the University of Guelph. The objective of the NAC is to provide the participating institutions with a signficant research presence in the international arena, as well as an improved operational capacity for analysis of longer-term agri-food policy issues. The departmental requirements for this type of analysis have increased significantly over the past few months, given the changing U.S.-EEC policies and the initiation of the General Agreement on Tariff and Trade (GATT) round of talks focusing on agriculture and on domestic policies.

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TABLE 1. SCOPE OF FARM

Commodity sector	Number of equations	Geographic coverage
Grains and oilseeds	113	regional
Wheat		
Durum		
Rye		
Oats		
Barley		
Rapeseed		
Flaxseed		
Soybeans		
Beef and pork	203	regional
Calves		
Steers		
Heifers		
Cows and bulls		
Hogs		
Beef: Inspected		
High quality		
Low quality		
Uninspected		
Pork		
Poultry and eggs	39	national
Chicken		
Turkey		
Eggs		
Dairy	53	national
Dairy cows, heifers		
Industrial, fluid milk		
Creamery butter		
Whole milk cheese		
Evaporated milk		
Skim milk powder		
Sheep and lambs	19	national
Sheep		
Lambs		
Mutton and lamb		

TABLE 1. SCOPE OF FARM (contd.)

Commodity sector	Number of equations	Geographic coverage
Food sector	99	national
Rail freight rate for meats	1	
Weekly earnings in food PDR	4	
Food marketing cost indexes	18	
Consumer price indexes	54	
Consumer income, expenditures	9	
Annual per capita food demand	13	
Farm income	163	
FCC lending rate	1	national
Farm input price indexes	29	"
Farm employment wage rates	6	"
Capital investment and stocks	22	"
Value of farm capital	4	"
Farm debt outstanding	1	"
Farm expenses and depreciation	23	"
Indexes of farm prices	19	regional
Indexes of farm production	12	national
Farm cash receipts	39	regional
Value of inventory change	1	national
Farm income		
Total, realized, and in-kind	5	"
Accrued	1	"
Other	26	
Productivity indexes	13	"
Gross output, value-added, and intermediate inputs	10	"
Other	3	"

Source: Eric Johannsen, The Food and Agriculture Regional Model, Policy Branch, Agriculture Canada, Ottawa, December 1986.

TABLE 2 FARM LEVEL MODELS

Model category	Type and description	Regional applicability	Current status	Remarks
Whole farm dynamic simulation model	(Lethbridge type) 1. Prairie grain	Prairie provinces and Peace River region	Up and running	Periodic update and revision required
	2. Beef-forage-grain	"	"	"
	3. Hog-grain	"	"	"
	4. Ontario grain	Ontario	"	"
	5. Dairy	All regions	"	"
Whole farm dynamic simulation/ optimisation model	Representative Farm (REPFARM) Model adapted from USDA for all farm types	All regions	"	Need revision to reflect Canadian taxation and policy situation
Physical/ economic model	Soil Conservation Economics (SOILEC) Model for all farm types	All regions	"	
Enterprise model (static)	Microcomputer Budget Management System (MBMS) (universal system for all farm types and enterprises)	All regions	"	Development mostly complete

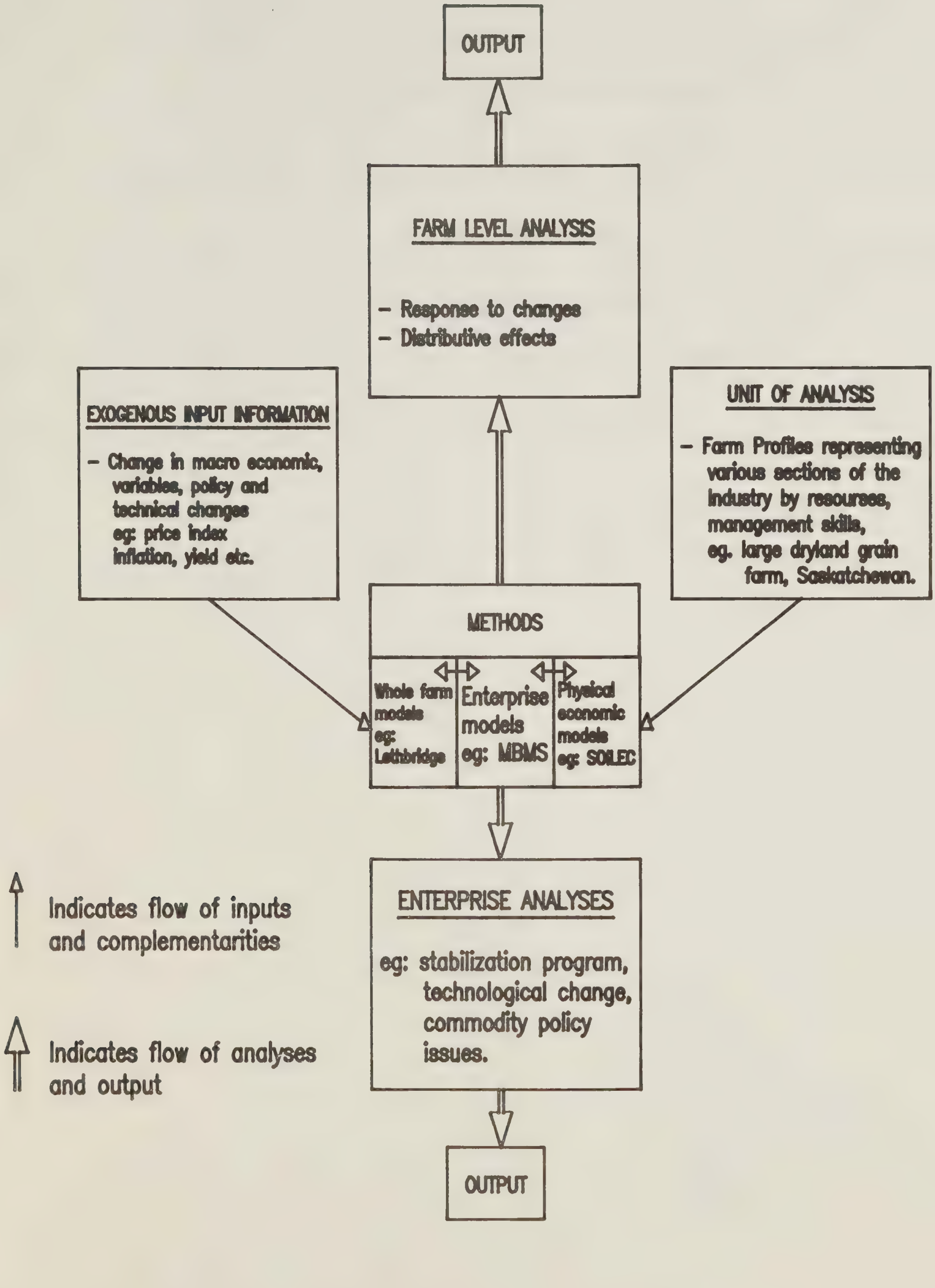
TABLE 3 FARM SUBSECTOR AND ENTERPRISE PROFILES

Farm subsector/ enterprise type	Region	Current Status	Remarks
Grains and oilseeds	Prairies provinces and Peace River region, B.C. by Brown, Dark Brown and Black soil zones	10 whole farm profiles available for three sizes (small, medium, large)	Completed as of 1984; to be revised soon
	Ontario SW, E, and W regions	3 whole farm profiles available representing average situation	Completed as of 1983; to be revised soon
Beef-forage-grain by subtypes	Prairie provinces by Brown, Dark Brown and Black soil zones	11 whole farm profiles available for three sizes (small, medium, large), and for cow-calf, yearling, feeder and feed lot finish subtypes	Completed as of 1984; to be revised soon
	Quebec by three subregions	9 whole farm profiles available for three sizes (small, medium, large) for beef feedlot subtype only	Completed recently
Hog-grain	Saskatchewan	3 whole farm profiles available for three sizes, (small, medium, large)	Completed as of 1984; to be revised soon
Potatoes	P.E.I., N.B., Quebec and Ontario	Enterprise profiles in a whole farm context available for typical situations	Recently completed for budget analysis
Sugarbeet	Quebec, Manitoba, Alberta	"	"
White beans	Ontario	Whole farm and enterprise profiles available by three sizes and technology types	"
Livestock	Prairies provinces Ontario, Quebec	Currently in progress	-

TABLE 4 FARM LEVEL ANALYSES OUTPUT

Analysis Projects	Remarks	Outputs
Farm-level impact of changes in energy prices, inflation, and interest rates	Completed in 1982-83	CFE article, 1983 and internal reports
Impact of new crop introduction	Completed in 1983	Reports internally circulated
Impact of fertilizer placement and ridge cultivation	Completed in 1984	Working papers published, 1984
Impact of Alternative methods of Crow benefit payment	Completed 1984-85	Working paper published, 1985
Farm-level impact of special grains program	Completed 1986	Internal reports prepared
Analysis of farm financial viability and profitability of beef and grains farms	Projects in progress (1987)	
On-farm economics of soil erosion	Completed in 1986	CFE article published, 1986
Enterprise and whole whole farm cost of production analysis	Enterprise budgets for sugarbeet, potato, corn, soybean, and white beans, in selected provinces; completed in 1986-87 Livestock (cow-calf and dairy) enterprise budgets in progress currently	

FIGURE 1 FARM AND ENTERPRISE LEVEL MODELING AND ANALYSIS



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